Back to results (F41H13/0075);

Methods and apparatus to disrupt the engine of a vehicle

Classifications

F41H13/0075 Directed energy weapons, i.e. devices that direct a beam of high energy content toward a target for incapacitating or destroying the target the high-energy beam being a radiofrequency beam

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IL222701A
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Worldwide applications

2012 • EP IL

Application IL222701A events

2012-02-13 • Priority claimed from US13/372,073

2012-10-25 • Application filed by Raytheon Co

2017-01-31 • Publication of IL222701A

Info: Patent citations (3), Cited by (2), Legal events, Similar documents, Priority and Related Applications

External links: Espacenet, Global Dossier, Discuss

Claims (11)

Hide Dependent

1. A system, comprising: a transmit antenna configured to transmit a range of frequencies targeting a target vehicle; a controller configured to control frequencies transmitted by the transmit antenna; a receive antenna configured to receive information from the target vehicle; and a signal processor configured to monitor the performance of an engine of the target vehicle by processing information from the receive antenna to identify a frequency transmitted by the transmit antenna that disrupts operation of the engine of the target vehicle, wherein once the disruptive signal is identified the controller controls the signal transmitted by the transmit antenna to dwell on the frequency that disrupts the engine.

2. The system according to claim 1, wherein a range of frequencies for transmission by the transmit antenna range in a specific region of the VHF/UHF bands.

3. The system according to claim 1, wherein the information from the receive antenna includes ignition timing.

4. The system according to claim 1, wherein the dwell frequency disrupts operation of an engine control unit

(ECU) coupled to the engine.

5. The system according to claim 1, wherein the transmit antenna comprises an array.

6. The system according to claim 1, wherein the system is mounted on a remote vehicle.

7. The system according to claim 1, further including a vehicle checkpoint along a vehicle pathway. 222701/2

8. A vehicle checkpoint system, comprising: at least one system to disable vehicles, comprising: a transmit antenna configured to transmit a range of frequencies to a target vehicle; a controller configured to control frequencies transmitted by the transmit antenna; a receive antenna configured to receive information from the target vehicle; and a signal processor configured to monitor the performance of an engine of the target vehicle by processing information from the receive antenna to identify a frequency transmitted by the transmit antenna that disrupts operation of the engine of the target vehicle, wherein once the disruptive signal is identified the controller controls the signal transmitted by the transmit antenna to dwell on the frequency that disrupts the engine.

9. The system according to claim 8, wherein the at least one system to disable vehicles is hidden.

10. A method, comprising: transmitting by a transmit antenna a range of frequencies targeting a target vehicle; controlling frequencies transmitted by the transmit antenna; receiving at a receive antenna information from the target vehicle; monitoring performance of an engine of the target vehicle; determining from the received information a first frequency in the range of frequencies that disrupts operation of the engine of the target vehicle from the engine performance monitoring; and dwelling on the first frequency to maintain disruption of the engine.

11. The method according to claim 10, wherein the vehicle comprises or more of an automobile, a truck, a boat, a helicopter, and/or snowmobile.

Description

222701/2 20 inn «hi D pnni Jticw METHODS AND APPARATUS TO DISRUPT THE ENGINE OF A VEHICLE RAYTHEON COMPANY C: 77210 222701/2 METHODS AND APPARATUS TO DISRUPT THE ENGINE OF A VEHICLE 10 BACKGROUND [0001 - 0002] As is known in the art, there are a variety of techniques to deal with vehicle drivers that do not operate their vehicle safely or have bad intentions. Exemplary techniques include road blocks, barricades, and tack strips. However, these techniques may have limited effectiveness 15 and may present safety issues. For example, obstacles such as barricades, patrol cars, nets, and tack strips on a public road, can create dangerous conditions if vehicle operators escalate the situation. A driver may attempt to go through a roadblock by speeding through barricades. Furthermore, roadblocks typically require the services of law enforcement officers for setup, which requires advance notice and planning. In the event that the vehicle forces its way through 20 the barricade, oficers may engage in a dangerous high-speed pursuit.

[0003] Other known techniques for stopping vehicles include the use of electromagnetic pulse (EMP) or high power microwaves to disrupt the electronic components of the vehicles. However, the use of EMP to disable a moving vehicle requires high energy levels that are dificult to 25 deploy in the field. Similarly, the use of high power microwaves requires a high power microwave source that is dificult to deploy and package. Furthermore, EMP and high power microwaves may be unsafe for people in the area of application. When high power microwaves or EMPs are used to stop a moving vehicle, microwave radiation is directed toward the vehicle to disable or inhibit electronic components of the vehicle. It is dificult to direct the microwave 30 energy directly against a single vehicle. Thus, when the microwave radiation is adapted to disable a particular vehicle's electronic components, all or many of the vehicles in the vicinity of 222701/2 the targeted vehicle may also be temporarily or permanently disabled. Disabling non-targeted vehicles may become a hazard to law enforcement personnel and public. [0003a] US 4,619,231 provides a system applicable to various internal combustion engines, such as for automobiles, motorcycles, snowmobiles and outboards, to permit an authorized person, such as a police officer, to prevent their improper or illegal operation. The engine includes a detector detecting the speed of operation of the motor which is compared with a preset value. Upon an unusually high motor speed being reached a receiver is enabled for a preset period of time. During this preset period the engine can be disabled by a transmission from a transmitter operated by the police officer, preferably using a designated exclusive channel. The disabling slows the engine to an idle speed without stopping it, so that the power assist

mechanisms of the vehicle remain operative to maintain normal braking and steering function. [0003b] WO 2011/046777 discloses a low power remote vehicle stopper with feedback that can disable a moving vehicle with a low power microwave interruption signal. According to one embodiment, a system for disrupting an internal combustion engine is provided. The system includes a receiver for wirelessly receiving an emitted signal from the internal combustion engine, the emitted signal corresponding to an operational parameter of the internal combustion engine, a signal generator for generating an interruption signal in accordance with the emitted signal, and a transmitter for transmitting the interruption signal to disrupt an operation of the internal combustion engine. [0003c] US 2008/0223641 discloses a method and apparatus for remotely disabling a vehicle using modulated microwave energy. The modulation characteristics are preferably tailored for different types of vehicles. This approach enables the use of a low power radiation source, which minimizes injury to people and property and which enables the use of portable devices, such as for use on law enforcement or military vehicles.

SUMMARY

[0004] The present invention provides method and apparatus for disabling a vehicle by disrupting an engine control unit (ECU). In an exemplary embodiment, a receiver is used to monitor engine parameters, such as ignition timing, to detect disruption caused by a particular 222701/2 frequency transmitted by a transmit antenna. The system can dwell on this frequency to disable the vehicle. With this arrangement, a vehicle can be quickly and safely disabled. While exemplary embodiments of the invention are shown and described in conjunction with particular frequencies, power, vehicles and engine control unit characteristics, it is understood that embodiments of the invention are applicable to applications in which it is desirable to disrupt and/or stop an engine.

[0005] In one aspect of the invention, a system comprises: a transmit antenna, a controller to control frequencies transmitted by the transmit antenna, a receive antenna, and a signal processor to process information from the receive antenna to identify a frequency transmitted by the transmit antenna that disrupts operation of an engine, wherein the controller controls the signal transmitted by the transmit antenna to dwell on the frequency that disrupts the engine.

[0006] In another aspect of the invention, a vehicle checkpoint system comprises: at least one system to disable vehicles, comprising: a transmit antenna, a controller to control frequencies transmitted by the transmit antenna, a receive antenna, and a signal processor to process information from the receive antenna to identify a frequency transmitted by the transmit antenna that disrupts operation of an engine, wherein the controller controls the signal transmitted by the transmit antenna to dwell on the frequency that disrupts the engine.

[0007] In a further aspect of the invention, a method comprises: transmitting a range of frequencies targeting a vehicle, monitoring performance of an engine of the vehicle, determining a first frequency in the range of frequencies that disrupts operation of the engine from the engine 2a 222701/2 performance monitoring, and dwelling on the first frequency to maintain disruption of the engine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The foregoing features of this invention, as well as the invention itself, may be more fully understood from the following description of the drawings in which:

[0009] FIG. 1 is a schematic representation of an exemplary vehicle disruption system in accordance with exemplary embodiments of the invention;

[0010] FIG. 2 is a schematic representation of a checkpoint having at least one vehicle disruption system;

[0011] FIG. 3 is a pictorial representation of a transmit antenna array that can form a part of the system of FIG. 1;

[0012] FIG. 4 is a flow diagram showing an exemplary sequence of steps for implementing vehicle disruption in accordance with exemplary embodiments of the invention; and

[0013] FIG. 5 is a schematic representation of an exemplary computer that can perform at least of the processing for vehicle disruption.

DETAILED DESCRIPTION

[0014] In general, exemplary embodiments of the invention enable disruption of an engine control unit (ECU) of a vehicle. In one embodiment, a system employs a scanning VHF/UHF signal using RF tones to disrupt the vehicle ECU, detect the disrupting frequency, and dwell on the disrupting frequency to bring the vehicle to a stop. Exemplary embodiments of the system c an be located at fixed location, such as a checkpoint, a mobile vehicle, or other platform. 3 222701/2

[0015] FIG. 1 shows an exemplary vehicle disruption system 100 in accordance with exemplary embodiments of the inventi o n. The system includes a transmit antenna 102 to transmit a range of frequencies while illuminating a target 10, such as vehicle. A signal controller 104 controls the characteristics of the transmitted signals.

[0016] A receive antenna 106 receives a signal emitted by the internal combustion engine ignition system of the vehicle 10. A signal processor 108 is coupled to the receive antenna 106 and to a control module 110 that controls overall operation of the system. A user interface 112 is coupled to the controller 110 to enable a user to interact with the system.

[0017] In general, signals emitted by the engine correspond to the vehicle ignition timing and other characteristics that factor in to frequency susceptibility of the internal combustion engine. The signal processor 108 analyzes the received information and determines scan and dwell tones that can be transmitted by the transmit antenna 102 to initiate disruption and eventual default of the ECU controlling the ignition timing of the internal combustion engine. In general, the signal controller 104 controls scan and dwell signal transmission over a defined frequency range to determine the optimally disruptive frequency tone by monitoring the ignition response. Continued signal transmission at the frequency of susceptibility results in ECU default until the signal is removed.

[0018] In one embodiment, a selected area is radiated for one or more specific vehicles. Since the transmitted frequency corresponds to engine timing for a specific vehicle, the system can disrupt a targeted vehicle in the midst of several vehicles without affecting the non-targeted vehicles. With an array for the transmission, the beam width can be narrow or wide depending on the application.

[0019] It is understood that with feedback from engine operation, it can be determined what frequency is effective to disrupt the engine ECU. It is believed that signals are coupling into the ECU through its wiring harness to cause the disruptive effect. It is believed that the disruptions are temporary because the communication between the ECU and sensors are ‘jammed’ . 4 222701/2

[0020] By disrupting the vehicle ECU, the engine wall stop in milliseconds. The ECU can go into a default mode in seconds, thereby requiring much less to power (e.g., 8 dB) to maintain disruption to the ECU and prevent the engine from restarting. Upon removal of the disrupting signal, the ECU can regain normal functionality without damage.

[0021] The dosed loop feedback determines the most disruptive frequency tone to produce an ECU default. In addition, this results in an inability of the ECU to reacquire at a much lower power level. The disruptive dwell tone may he modulated to reduce the power level compared with a continuous wave transmitted tone.

[0022] It has been found that most ECUs have susceptible frequencies that fall within VHF and UHF bands. In one embodiment, a transmitter includes a power combined GaN Amplifier for provide CW power in the older of 170 kW for ECU disruption at about 100m and for 10m about 17W.

[0023] In one embodiment shown in FIG. 2, a series of vehicle disruption systems 200a-N are distributed along a vehicle pathway 20. The distributed systems are synchronized by a remote receiver/processor to focus the energy at a target vchicle/ECU 10 With this arrangement, higher levels of energy are present at the target 20 to minimize energy levels in the area in the pathway vicinity. In one embodiment, a single receive antenna monitors engine operation of a targeted vehicle. This arrangement is well suited for vehicle checkpoints, such as border crossings.

[0024] In an exemplary embodiment, vehicle disruption systems are hidden and/or camouflaged. An aggressive

vehicle can be disabled from a hidden disruption system. An operator of the vehicle may not even be aware that the vehicle has been targeted for disruption

[0025] It should be noted that no a priori information is required by exemplary embodiments of a vehicle disruption system. The system 100 illuminates the vehicle over a range of frequencies, monitors a response of the vehicle engine, and identifies the frequency of the signal that disrupts operation of the vehicle ECU. 5 222701/2

[0026] It is understood that embodiments of an inventive vehicle disruption system can be used for any vehicle having electronic ignition control Exemplary vehicles include automobiles, motorcycles, boats, armored vehicles, snowmachines, and the like.

[0027] A variety of suitable antennas can be used. In one particular embodiment, a transmit antenna comprises a series of antennas identified as Part No, FRF-110A from First RF corporation in Boulder, CO. In one embodiment shown in FIG. 3, the antennas are arranged in a 3 x4 lattice on a mobile platform shown as a truck. In one embodiment, the receive antenna is an omni operating at frequencies higher than those of the transmit antenna.

[0028] FIG. 4 shows an exemplary sequence of steps for providing vehicle disruption in accordance with exemplary embodiments of the invention. In step 400, an object of interest, such as a vehicle, is targeted. The target is illuminated by transmitting signals in a range of frequencies in step 402. During illumination of the vehicle, in step 404 a receive antenna monitors operation of the engine, such as ignition timing. In step 406, the information from the receive antenna is used to detect disruption of engine operation due to the signals from the transmit antenna. More particularly, the system analyzes operation of the engine to identify the specific frequency that produces the most disruption. It is understood that transmit and receive operations are coordinated in a known manner. In step 408, the signal of maximum disruption is transmitted by the transmit antenna to disable the vehicle. Once the vehicle is disabled, the power level can be decreased to a level that prevents restart of die engine.

[0029] It is understood that engine operating characteristics can be stored in a database, as described in U.S. Patent Application No. 12,581,087, which published as US 2011/0093180 A1 .

[0030] Referring to FIG. 5, a computer includes a processor 502, a volatile memory 504, an output device 505, a non-volatile memory 506 (e.g., hard disk), and a graphical user interface (GUI) 508 (e.g., a mouse, a keyboard, a display, for example). The non-volatile memory 506 stores computer instructions 512, an operating system 516 and data 518, for example. In one example, the computer instructions 512 are executed by the processor 502 out of volatile memory 504 to perform all or part of the processing described above. An article 519 can 6 222701/2

Patent Citations (3)

Publication number	Priority date	Publication date	Assignee	Title
Family To Family Citations				
US5907290A *	1997-08-22	1999-05-25	The United States Of America As Represented By The Secretary Of The Army	In-road microwave vehicle stopper
WO2008118532A2 *	2007-01-30	2008-10-02	Fiore Industries, Inc.	Method and apparatus for remotely disabling vechicles
US8116966B2 *	2009-10-16	2012-02-14	Raytheon Company	Low power microwave vehicle stopper with feedback

* Cited by examiner, † Cited by third party

Cited By (2)

Publication number	Priority date	Publication date	Assignee	Title
Family To Family Citations				
GB201404209D0 *	2014-03-10	2014-04-23	E2V Tech Uk Ltd	Method and apparatus for remotely disabling vehicles
RU2657143C1 *	2015-11-06	2018-06-08	Евгений Алексеевич Куликов	System of remote stopping of vehicles

* Cited by examiner, † Cited by third party, ‡ Family to family citation

Similar Documents

Publication	Publication Date	Title
US12084049B2	2024-09-10	Actions to avoid or reduce the harm of an imminent collision
US8116966B2	2012-02-14	Low power microwave vehicle stopper with feedback
US9079555B2	2015-07-14	Methods and apparatus to disrupt the engine of a vehicle
US6072248A	2000-06-06	Method of and system for externally and remotely disabling stolen or unauthorized operated vehicles by pursuing police and the like
US10189474B2	2019-01-29	Vehicle control system and method
US6897762B2	2005-05-24	Vehicle immobilization system
US9279881B2	2016-03-08	Radar false alert reduction
US20090215387A1	2009-08-27	In-vehicle cellular device blocker to restrict cellular use for operator
JP2009031053A	2009-02-12	Device for detecting forward obstacle
CN1606889A	2005-04-13	Use controller for a wireless communication device
EP2626662B1	2015-04-15	Methods and apparatus to disrupt the engine of a vehicle
US7215276B2	2007-05-08	Radar detector
US5907290A	1999-05-25	In-road microwave vehicle stopper
KR102443265B1	2022-09-13	Remote vehicle disabling device and method
US20160363650A1	2016-12-15	Radar detector frequency disturbance sensor filtering system and method
RU2657143C1	2018-06-08	System of remote stopping of vehicles
KR20100077420A	2010-07-08	Remote vehicle stop system

Publication	Publication Date	Title
US6373379B1	2002-04-16	Automobile security system with location and panic alerts
US12233860B2	2025-02-25	Collision avoidance and minimization using an AI model
CN116133351A	2023-05-16	Anti-disclosure system and method applied to intelligent driving vehicle

Priority And Related Applications

Applications Claiming Priority (1)

Application	Filing date	Title
US13/372,073	2012-02-13	Methods and apparatus to disrupt the engine of a vehicle

Legal Events

Date	Code	Title	Description
2017-05-29	FF	Patent granted	
2017-07-31	KB	Patent renewed	
2018-10-31	KB	Patent renewed	

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